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EVALUATION OF R-55 AND MESTRANOL TO PROTECT DOUGLAS-FIR SEED FROM DEER MICE

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ABSTRACT

Bioassays using deer mice showed that R-55, a thiocarbamate derivative, applied as 2- and 5-percent coatings was ineffective in reducing consumption of Douglas-fir seed. At 2 percent, mestranol, an antifertility chemical, reduced seed consumption to levels comparable with endrin applied at 0.5 percent without impairing germination.

Keywords: Seed treatment, mice, biological assay, pesticides.

INTRODUCTION

Losses of conifer seed to rodents have plagued reforestation efforts for many years, and much has been written about efforts to control these losses (Radwan 1970). In 1956, a chemical treatment based on endrin[1/] was introduced to protect the seeds of many conifer species from seed-eating rodents (Anonymous 1956). However, present concern over pesticide hazards dictates that endrin, a persistent chlorinated hydrocarbon, be replaced as a seed protectant with a safer chemical.

Recent work in Canada indicated that R-55 (a thiocarbamate derivative produced by Phillips Petroleum Co.) effectively reduced consumption of white spruce (*Picea glauca*) seed by deer mice (*Peromyscus*) (Radvanyi 1970). About the same time, Howard and Marsh (1969) reported that mestranol (an antifertility chemical produced by Syntex Laboratories) was often poorly accepted by rats (*Rattus norvegicus*) and voles (*Microtus* spp.) suggesting that the compound might be useful as a rodent repellent for protecting conifer seed. In this study, therefore, we conducted trials with both R-55 and mestranol on Douglas-fir (*Pseudotsuga menziesii*), the major species seeded in the Pacific Northwest. Evaluations were based on laboratory bioassays using deer mice (*P. maniculatus*) as test animals and endrin as a chemical standard. Also, seeds of effective treatments were germinated to detect possible adverse effects of the chemicals employed.

MATERIALS AND METHODS

Seed treatment.--One seed lot of Douglas-fir from a low-elevation source in western Washington was used for all treatments. Seed, in 1/10-pound batches, was coated with each of the test chemicals using 4 milliliters (ml.) Dow Latex 512-R (diluted, 1 latex: 9 water by volume) as adhesive and 0.4 ml. DuPont Monastral Green GW 794 dye as coloring agent. In each case, seed was wet with a slurry of the test chemical in the adhesive-dye mixture, spread in a thin layer, and allowed to dry overnight under a hood at room temperature.

[1/] Mention of chemical companies and their products does not represent endorsement by the Forest Service or the U.S. Department of Agriculture.

Concentration percents of the active ingredients by weight were: 2 and 5 for R-55, 1 and 2 for mestranol, and 0.5 for endrin. The R-55 and mestranol powders were provided by Phillips Petroleum Company and Syntex Laboratories, Inc., respectively. Endrin was purchased as a 50-percent wettable powder (50-WP, Stauffer Chemical Co.).

Bioassays.--Deer mice live-trapped near Tumwater, Washington, in winter 1970-71, were used in all bioassays. Each trial was conducted with freshly caught mice which were brought to the laboratory, placed in individual cages, and supplied with water and a commercial pelleted ration until testing. One day prior to each trial, mice were offered a number of untreated Douglas-fir seeds equal to that subsequently used in the test. Animals not consuming at least 90 percent of the seeds were rejected from testing, and treatments were assigned at random to remaining mice. Seeds were offered in petri dishes, and water and food pellets were available *ad libitum* during each trial.

The number of mice per treatment, number of seeds offered each day, or duration of test was varied in each trial in order to evaluate the response of the animals to the treatments under several different conditions. In trial 1, 10 mice were offered 10 seeds per day for 5 consecutive days; in trial 2, five were given 25 seeds per day for 3 days; and in trial 3, five were fed 50 seeds per day for 3 days. Seed consumption was recorded daily, and the number of dead mice was noted each day during the trial and for 2 days after.

Germination.--Four 100-seed replicates were germinated on perlite at 24±1° C. after stratification for 21 days at 3° to 5° C., as prescribed in the standard test (Association of Official Seed Analysts 1965). Germinants were counted at weekly intervals and tests were run for 4 weeks.

Germinations of the seed coated with 2 percent mestranol, 0.5 percent endrin, and without treatment were determined. Seeds of other treatments were not germinated because the 1 percent mestranol was less effective in reducing consumption than the 2-percent treatment, and R-55 proved ineffective.

RESULTS AND DISCUSSION

Results of bioassays were similar in all trials (table 1). Consumption of seed was reduced markedly by treatment with endrin and mestranol but not by R-55. Animal mortality was low from all treatments. Feeding on seed treated with mestranol at 1 percent was not significantly different from that treated with R-55, 2 percent or 5 percent in trial 1, and therefore was not tested in trials 2 and 3. R-55 at 2 percent was similarly eliminated from subsequent tests. Untreated seed was not included as a treatment because many previous bioassays have shown that it was virtually always completely consumed (Radwan et al. 1970).

Average total germination percents over the 4-week period for seed coated with 0.5 percent endrin, 2 percent mestranol, and untreated were 81, 77, and 80, respectively, with no significant differences among treatments. Seed coatings with either endrin or mestranol did not affect seed viability. Germination of endrin-treated seed is in agreement with earlier data (Radwan et al. 1970), and the mestranol result shows that the chemical does not inhibit germination of Douglas-fir.

Laboratory results revealed no protective benefits from R-55 treatment of Douglas-fir seed using the method of seed treatment currently employed in the Pacific Northwest, and an established bioassay technique. In other tests not detailed here, mice were offered: (1) seed soaked in a solution of R-55 in dichloroethane similar to the dichloroethane-endrin treatment described by Radwan et al. (1970), and (2) untreated seed concurrently with seed treated with either R-55 or endrin. In both instances, R-55 had no effect whereas endrin markedly lowered seed consumption.

Our results contrast with those of Radvanyi (1970) who found that treating white spruce seed with R-55 greatly reduced its consumption. His seed species, method of seed treatment, and bioassay techniques were very different from those reported here, and the differences in findings could be related to any or all of these factors.

The promising results from mestranol justify continued research on it and similar compounds, although we clearly recognize that protective benefits shown in laboratory bioassays may not be attainable under field conditions. Moreover, the current high cost of mestranol might preclude its use even if the compound was proven effective and environmentally acceptable.

Table 1.--*Consumption of chemically treated Douglas-fir seed by deer mice and resulting animal mortality*

Treatment	Seed consumption		Animal mortality
	Mean number 1/	- - - - *Percent* - - - -	
TRIAL 1--10-ANIMAL, 10 SEEDS PER ANIMAL PER DAY, 5-DAY TEST			
R-55, 2 percent	49.6 a	99.2	0
R-55, 5 percent	49.5 a	99.0	0
Mestranol, 1 percent	37.5 ab	75.0	0
Mestranol, 2 percent	28.2 bc	56.4	0
Endrin, 0.5 percent	21.4 c	42.8	0
TRIAL 2--5-ANIMAL, 25 SEEDS PER ANIMAL PER DAY, 3-DAY TEST			
R-55, 5 percent	74.6 a	99.5	0
Mestranol, 2 percent	28.0 b	37.3	0
Endrin, 0.5 percent	24.8 b	33.1	0
TRIAL 3--5-ANIMAL, 50 SEEDS PER ANIMAL PER DAY, 3-DAY TEST			
R-55, 5 percent	147.6 a	98.4	0
Mestranol, 2 percent	64.8 b	43.2	0
Endrin, 0.5 percent	47.6 b	31.7	20

1/ Means followed by the same letter are not significantly different at the 5-percent level using Tukey's test (Snedecor 1961).

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